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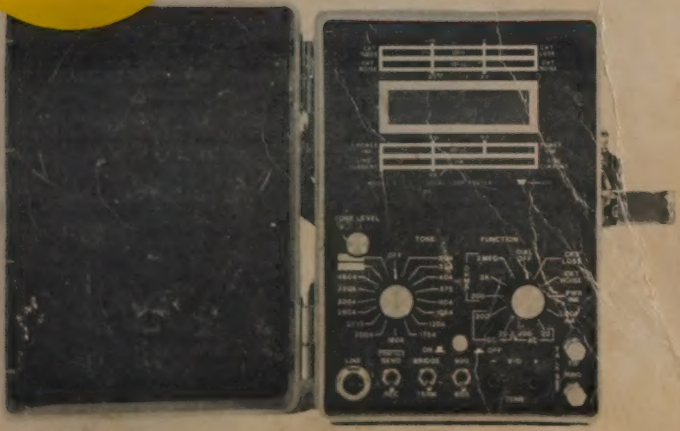

MODEL 5
LOOP TESTER

TRIPLETT
A Penril COMPANY

INSTRUCTION MANUAL

INSTRUCTION MANUAL

MODEL 5

LOOP TESTER

TRIPLETT®
A Penril COMPANY

Triplett Corporation
One Triplett Drive
Bluffton, Ohio 45817

SAFETY RULES

Caution

This tester had been designed with your safety in mind. However, no design can completely protect against incorrect use. Electrical circuits can be dangerous and/or lethal when lack of caution or poor safety practices are used.

Read The Manual

Read this Instruction Manual carefully and completely.

Voltages and currents within the capability of this test equipment can be hazardous. Follow the instructions in this manual for every measurement. Read and understand the general instructions before attempting to use this tester. Do not exceed the limits of the tester.

Safety Check

Double check the switch setting and lead connections before making measurements. Are you following all of the instructions?

Do not connect to circuits with voltage present when switch is in any ohms or current position.

When replacing fuses use only specified type fuses and insert in correct fuse holder.

Don't Touch

Don't touch exposed wiring, connections or other "live" parts of an electrical circuit. If in doubt, check the circuit first for voltage before touching it.

Turn off the power to a circuit before connecting test probes to it. Be sure there is no voltage present before you touch the circuit.

Do not use cracked or broken test leads.

Distribution Circuits Pack A Punch

In high energy circuits such as distribution transformers and bus bars, dangerous arcs of explosive nature can occur if the circuit is shorted. If the tester is connected across a high energy circuit when set to a low resistance range, a current range, or any other low impedance range, the circuit is virtually shorted.

Special equipment designed for use with these circuits is available. Contact a qualified person for assistance before attempting to make measurements on any high energy circuit.

SAFETY IS NO ACCIDENT

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INTRODUCTION

The Model 5 Loop Tester is a general purpose instrument combining the test capabilities most needed by installation and repair personnel.

The Model 5 features a digital readout surrounded by a color coded label which gives the most used color coded limits for transmission tests.

In addition to the loop test functions an AC-DC Voltmeter and Ohmmeter are included. A tone generator with 15 switch selectable tones. Two additional tones are available on customer request or inserted later.

The tone generator output dB level is variable and can be monitored by the digital readout.

The unit is in a rugged plastic case with removable cover compartment used to store test leads and the operators manual. The tester has an adjustable carrying strap so it can be carried without the use of hands.

MODEL 5
PERFORMANCE SPECIFICATIONS
LINE MEASUREMENT SECTION

Circuit Loss

Range	−40 to +10 dBm, 0.1 dB resolution
OdBm Reference	1 mW across 600 Ohms
Accuracy	200 Hz to 5 kHz −30 dBm to 0 dBm ±0.2 dB 200 Hz to 10 kHz −40 dBm to +10 dBm ±0.5 dB
Temperature Coefficient	±0.02 dB/°C 0° to 50° C
Input Impedance	Terminated 600 or 900 ohms Bridged > 7500 ohms
D.C. Holding	Current Sink, Minimum current 20 mA with 46 Volts and line resistance of 1870 Ohms
Varistor Surge Protection	
Tone Output	Tones may be transmitted out the Transmission Test leads by switching Send/Receive to Send
Detector	True rms

Circuit Noise

Range	0 to 45 dBrnc 0.1 dB resolution
Accuracy	±0.5 dB, 0 to 15 dBrnc ±0.2 dB, 15 to 40 dBrnc ±0.5 dB, 40 to 45 dBrnc (Calibrated at 1000 Hz)
Temperature Coefficient	±0.04 dB/°C 0° to 50°C
Filter Accuracy	Meets Bell Technical Reference 41009 and 55020 "C" Message Weighting
Input Impedance	Terminated 600 or 900 ohms Bridged > 7500 ohms
D.C. Holding	Current Sink minimum current 20 mA with 46 Volts and line resistance of 1870 Ohms
Varister Surge Protection	
Detector	True rms

Power Influence (Noise to Gnd)

Range	50 to 100 dBrnc 0.1 dB resolution
Frequency Response	"C" message weighting
Accuracy	±0.5 dB (Calibrated at 1000 Hz)
Temperature Coefficient	±0.04 dB/°C 0° to 50°C
Detector	True rms
Input Impedance	Greater than 100 K ohms between tip or ring and GND.

Loop mA

Range	0 to 199.9 mA
Accuracy	At 20 mA ±.2 mA At other readings ±2% +0.2 mA

GENERATOR SECTION

Tone

Waveform	Sine Wave
Frequencies	204-304-404-575-804-1004-1204-1754-1804-2004-2713-2804-3004-3204-4804 Hz
Accuracy	804, 1004 −0 to +0.5% with internal adjustments for each frequency 2713 ±5 Hz All other frequencies −0 to +5%
Frequencies	Two (2) frequencies which may be specified by customer.
Quiet Termination	Quiet Termination supplied through tone output leads. (See instruction on Tone Generator)
Output Amplitude	Variable −40 dBm to approx. +5.5 dBm Output level monitored by meter
Level Accuracy	±.2 dB across 600 Ohms at output
Output Impedance	600 Ohms ±5%
D.C. Holding	Current Sink, Minimum current 20 mA with 46 Volts and line resistance of 1870 Ohms
Output	Available at V-O jacks when function SW. is set on CKT LOSS. Also available at LINE JACK when Send/Receive SW. is in the Send position. Tone Generator must be ON.
Overload Protection	Fused at V-O jacks, varistor surge protection

VOLT-OHMMETER

DC Volts	
Ranges	0-20, .01 V resolution; 0-200, .1 V resolution
Input Impedance	1 Meg Ohm
Accuracy	±(2% + 1 digit)
AC Volts	
Ranges	0-20, .01 V resolution; 0-200, .1 V resolution
Input Impedance	1 Meg Ohm
Accuracy	±(2% + 2 digits)
True rms Detector	
Frequency Response	40 Hz to 10 kHz ±2%
Ohms	
Ranges	0-200, 0-2000, 0-2 Meg
Maximum Open Circuit voltage	10 Volts
Maximum Current	Shorted leads
200 Ohm range	10 mA
2000 Ohm range	1.0 mA
2 Meg Ohm range	1.0 uA
Accuracy	±(2% + 1 digit)
Overload Protection	1 Amp Fuse

GENERAL

Display	0.5'', 3½ digit LCD (Liquid Crystal Display) with polarity indication
Overrange Indication	On Volts and Ohms functions, display blanks least significant digits with polarity indication
Auto Polarity	Positive implied, negative indicated
Operating Temperature	-20°C to 50°C
Relative Humidity	10 to 85% at 35°C non-condensing
Storage Temperature	−40°C to +60°C
Batteries	NEDA 9 Volt 1604A
Low Battery Indication	Shows on display
Size	5½''W x 7½''H x 5''D with cover
Weight	3½# Approx.

ACCESSORIES

Loop Test Leads	310 Jack to Modular Plug Modular Receptacle to 3 Western Electric style alligator Clips Marked Tip Ring Gnd
Volt-Ohmmeter Test Leads	Standard Banana Plug to Western Electric style alligator Clips Color - Red and Black

MODEL 5 LOOP TESTER
GENERAL INFORMATION

Applicable specifications as prescribed in the, (Subscriber Loop Transmission Test Set Publications 41009 and 55020), were used in designing the Model 5.

The Model 5 is battery powered. Normal field operation of several months should be experienced before batteries need replaced. A Lo Batt indicator on the LCD comes on when the battery voltage drops to approximately 6.8 Volts, indicating the batteries need replacing. For longest life Alkaline or Mercury batteries are recommended. Two Mallory MN 1604, NEDA 1604A or equivalent are needed.

Batteries and fuse are located at the top rear side of the tester. Access to the battery compartment is achieved by loosening one screw in the upper center of the back panel. When the screw has been disengaged, lift the cover up and out. See Figure #1 and #2.

The cover of the Model 5 is a container for the two types of test leads and the Operators Manual. It serves a third purpose. When the inner door is closed, closing the cover on the tester automatically presses a battery disconnect switch in the front control panel. This is to prevent battery drain when the tester is not in use.

BATTERY COVER REMOVAL

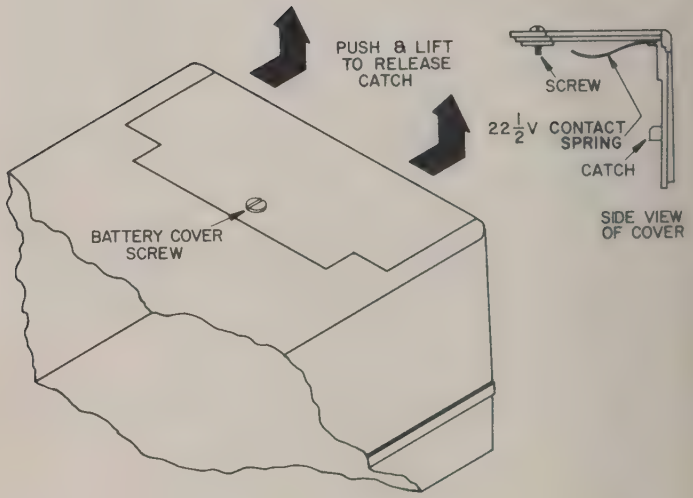


Figure 1

BATTERY AND FUSE LOCATION

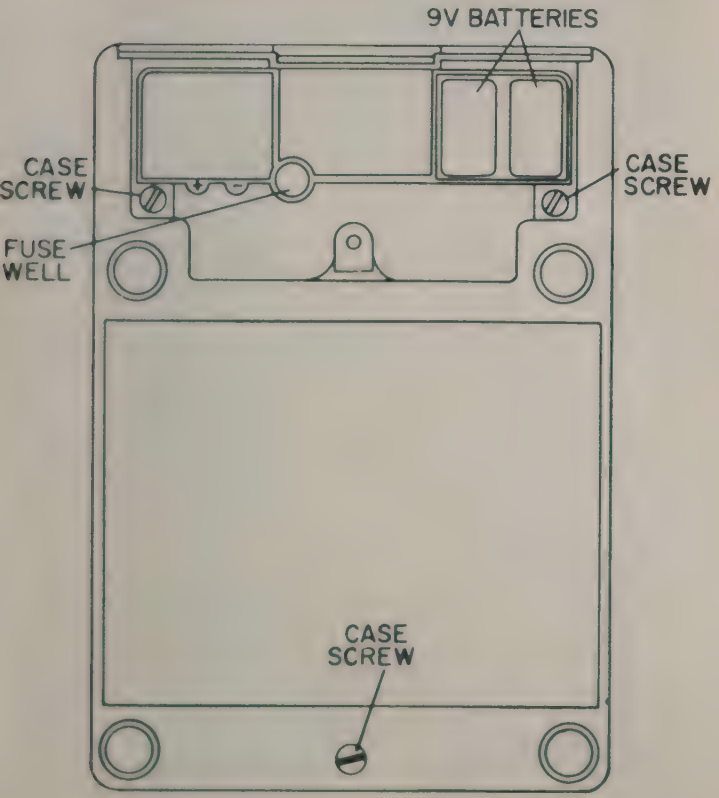


Figure 2

FUNCTION OF CONTROLS, JACKS TERMINALS AND LEADS

See Page 14, Figure #3

FUNCTION SELECTOR SWITCH

I. Selects desired measurement functions
   A. Line Transmission Measurements
      1. Line Circuit Loss
      2. Circuit Noise
      3. Power Influence
      4. Loop Current
   B. Volt-Ohmmeter
      1. AC Voltages
      2. DC Voltages
      3. Ohms

II. Off position directly connects Talk-Set terminals to the pair of wires being tested. Read dialing instructions.

TONE SELECTOR SWITCH

I. Selects desired tone frequency output.

II. Off Position connects a quiet termination across tone output jacks.

600 - 900 SWITCH

Selects the **input** termination for either 600 Ohm or 900 Ohms.

BRIDGE - TERM SWITCH

Level measurements can be made in either a high impedance or terminated mode.

SEND/RECEIVE SWITCH

SEND POSITION

In this position and with the function switch set on CKT LOSS, the output level of the tone generator is indicated on the LCD display, if the tone generator is set to one of the frequencies.

Adjustments of the tone level is made when the switch is turned to a tone and the tone level adjustment knob is turned. Level is indicated in dB. The OdB level is 775 mV across 600 Ohms.

The tone output termination and DC hold circuit is also switched to the Transmission Line Jack in the send position.

Refer to section on Generator operation for more detailed operating procedures.

RECEIVE POSITION

In this position the Transmission Line Jack is connected to the measurement circuits for CKT Loss, CKT Noise, PWR Influence and Line Current.

TRANSMISSION LINE JACK

This jack accepts the Western Electric 310 type plug. The test leads inserted in the jack are used for all transmission line tests.

V-O JACKS

These two jacks with the V-O leads are used for the Volt-Ohmmeter section of the tester and also as the TONE OUTPUT source. A tone output is present at these jacks whenever the Function Switch is in the CKT LOSS position and the TONE GENERATOR is turned to one of the frequencies. A 600 Ohm termination is present at these jacks in both CKT Noise and PWR Influence positions.

TALK SET TERMINALS

These two terminals are used to connect the operators hand set to the tester so that access numbers can be dialed, Loop-Around tests can be performed and tones monitored.

When the operators hand set is connected to these terminals and the Function Switch is turned to the OFF or DIAL position with the ON-OFF Button depressed the operator can dial into the pair being tested through the transmission test leads.

The second function of the TALK SET terminals is to monitor the line while performing the transmission line tests. The operators hand set must be in the monitor or high impedance mode if this feature is used.

TONE LEVEL ADJUST

Adjusts the level of all tones generated. The tone level can be seen and read for adjustment with the SEND RECEIVE switch in the Send position.

BATTERY DISCONNECT SWITCH

This is a PUSH-PUSH type switch wired to perform two functions.

1. When depressed, either manually or by closing the tester cover, the batteries are disconnected to prevent unnecessary battery drain in case TONE and FUNCTION switch are left ON. Pushing and releasing this switch activates the power supply so that tests can be made.

2. The second function of the switch is to connect the TALK SET terminals to the LINE JACK for dialing. Dialing is performed with the switch depressed.

MODEL 5
CONTROL LOCATION

Figure 3

OPERATING INSTRUCTIONS

SAFETY PROCEDURE

Care should be taken to not touch the exposed metal parts of the Western Electric style alligator clips as the operator is connecting them to the pair of wires to be tested. Care should also be taken not to touch the Talk Set Terminals or the exposed metal parts of the alligator clips attaching the serviceman's hand-set to those terminals. The reason to take care is that the voltage present in the pair of wires being tested has not been determined yet and it could be at a dangerous level.

IT IS THEREFORE RECOMMENDED THAT THE TALK SET BE CONNECTED TO TALK SET TERMINALS BEFORE INPUT TEST LEADS ARE CONNECTED TO TELEPHONE LINES OR LINES UNDER TEST.

DIALING INSTRUCTIONS (Fig. 4)

The BATTERY DISCONNECT switch is a Push-Push type switch which disconnects the 9 volt batteries when depressed and also switches the TALK SET terminals from the dialing to listening mode.

The following procedure should be followed when dialing and operating in any of the loop measurement positions.

1. The Push-Push battery disconnect switch should be in the depressed position and the Function Switch in the Off Dial position when dialing. The Send Receive switch should be in the Receive position.

2. After a dial tone is heard through the tester and the hand set, the access number for a tone source or quiet termination should be dialed.

3. When the connection has been established, the **Function Switch** is turned to CKT Loss, CKT Noise, PWR Influence or Line Current depending on what parameter is to be measured. **Then** the **Push-Push Switch** is pressed and released so that the switch is out.

4. Measurements are then made following the procedure in the manual. **Note** - If the Push-Push Switch is released to the out position before the Function Switch is turned to one of the loop function positions the connection will be lost.

5. If it is desired to reconnect the Talk Set to the line depress the battery disconnect switch and then turn the Function Switch to the DIAL-OFF position and the Send Receive switch to the Receive position.

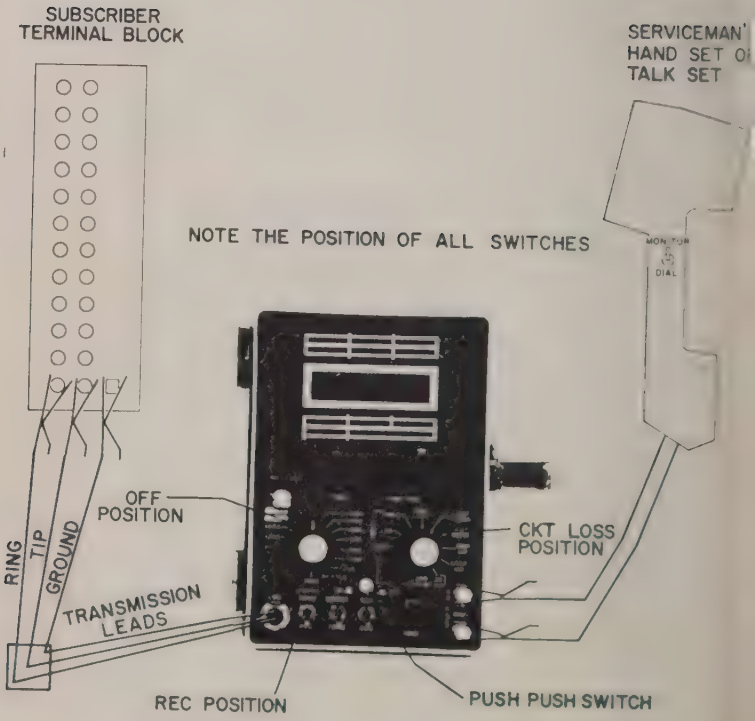

SUBSCRIBER
TERMINAL BLOCK
SERVICEMAN'
HAND SET O
TALK SET
NOTE THE POSITION OF ALL SWITCHES
MON TOR
DIAL
OFF
POSITION
CKT LOSS
POSITION
RING
TIP
GROUND
TRANSMISSION
LEADS
REC POSITION
PUSH PUSH SWITCH

Figure 4

Performing Tests With The Model 5

Testing For Circuit Loss - Standard Procedure

1. Plug the Transmission Test Leads into the Line jack. (See Illustration, Figure #5.)

2. Connect your hand-set to the Talk Set Terminals before you have connected the Transmission Test Leads to the pair of wires being tested. Switch your hand-set to the "Dial" position.

3. Check the two Rotary Selector Switches and make sure that they are turned to the off position. Check the Send/Receive Toggle Switch to make sure it is in the "Receive" position. The Push-Push switch sould be "Off."

4. Connect the three Transmission Test Leads to the pair being tested; Tip to Tip, Ring to Ring, and Gnd to Ground. If this is a live pair, the operator will hear a dial tone through his hand-set.

5. For Circuit Loss Testing following the Standard Procedure, the operator now dials the correct access number at the Central Office to receive a single 1004 Hz tone or an access number that will get three or more tones. Listen for the tone or tones.

6. Function Selector Switch is then turned to the 'Circuit Loss" position and the battery disconnect switch is pushed to release it. (See Illustration, Figure #5.)

The serviceman's hand-set should be switched to the monitor position.

7. Listen to the tone and record the Circuit Loss Level on this pair. If multiple tones are sent from the Central Office, they can be heard through the hand-set. Listen to the sequence of the tones and then record the Circuit Loss Level at each different tone frequency.

8. The operator may want to send tones to someone at a test position at the Central Office for the purpose of checking the Circuit Loss in the pair in both directions. This is very easily done with the Model 5.

A. Leaving the leads connected as they were for the previous testing, depress the battery disconnect Push Button, and turn the Function Switch to the "Off" position. Switch the hand-set to the "Dial" position. Dial the access number to the test desk or test position. Tell the person at the test position that you are going to send him one or more tones.

B. Switch the Function Switch to the "Circuit Loss" position. Release the Push-Button switch. Switch the Send-Receive Switch to the "Send" position. (See Illustration, Figure #6.)

TAKING A CIRCUIT LOSS MEASUREMENT
STANDARD PROCEDURE

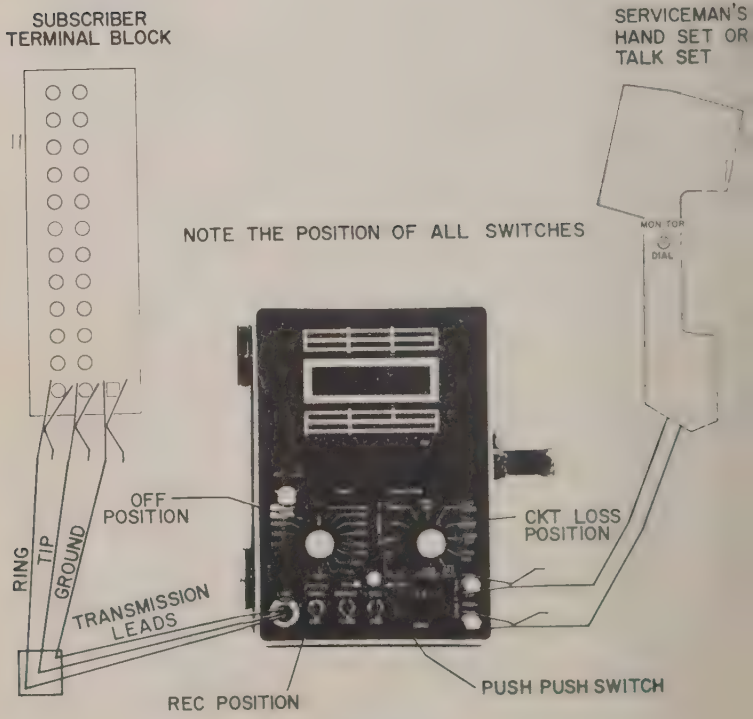


Figure 5

SENDING A TONE TO THE CENTRAL OFFICE THROUGH THE TRANSMISSION LEADS

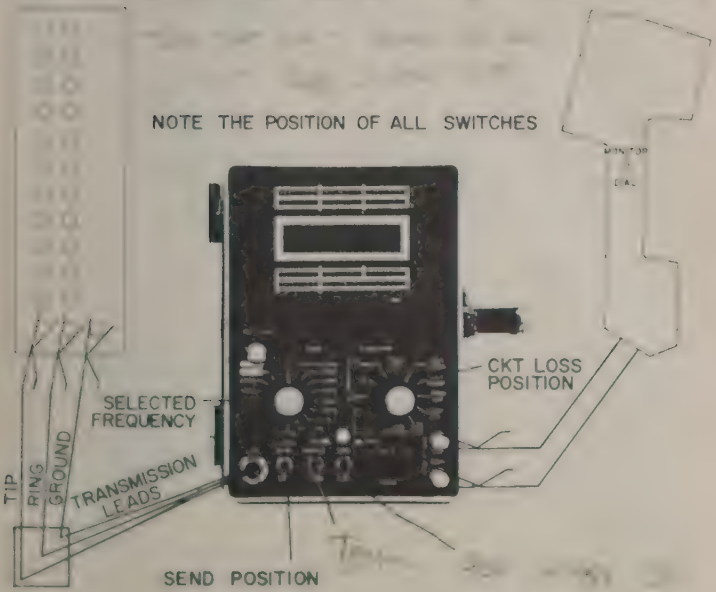


Figure 6

C. Now switch the Tone Selector Switch to any tone position. Adjust the tone to the desired level by means of the tone level control. Transmit level is indicated on the meter, that tone is being transmitted through the Transmission Test Leads to the Central Office. You will be able to monitor the outgoing tone through your hand-set. You can send several tones if you desire to.

Loop-Around Testing For Circuit Loss With The Model 5

1. Adjust Tone Level to 0 dB by setting switches to CKT LOSS, SEND, and TONE to any frequency. Adjust Tone Level for 0 dB on meter.
2. Follow Steps 1 through 4 as listed under "Testing For Circuit Loss - Standard Procedure".
3. Determine the second pair of wires to be used for loop-around test and connect the Tone leads to them.
4. Dial the number of the cable pair that is connected to the Tone leads.
5. When ringing is heard through hand set turn FUNCTION switch to CKT LOSS, Push-Push switch to ON, and hand set to monitor.
6. Select desired frequency on TONE switch which should be heard from hand set.
7. Record circuit loss as indicated on meter. Note that the loss is the combined loss of both cable pairs. If the acceptable loss in one pair is 8 dB then the loss in two pair should be less than 16 dB.
8. The operator has the ability to send as many as seventeen tones by rotating the Tone Selector Switch and read them with the same tester. The oscillator will transmit all tones at zero dB level once one of the tones has been set at zero without further need for adjustment.
9. If the leads are reversed and the Transmission Test Leads are first connected to the second pair, the operator can dial the number of the first pair and send the same tone or tones checking the Circuit Loss in the opposit direction.
10. If a reading lower than minus 16 dB is shown, use a third pair to identify which of the first two is the bad one.

PREPARING TO MAKE LOOP-AROUND TESTS

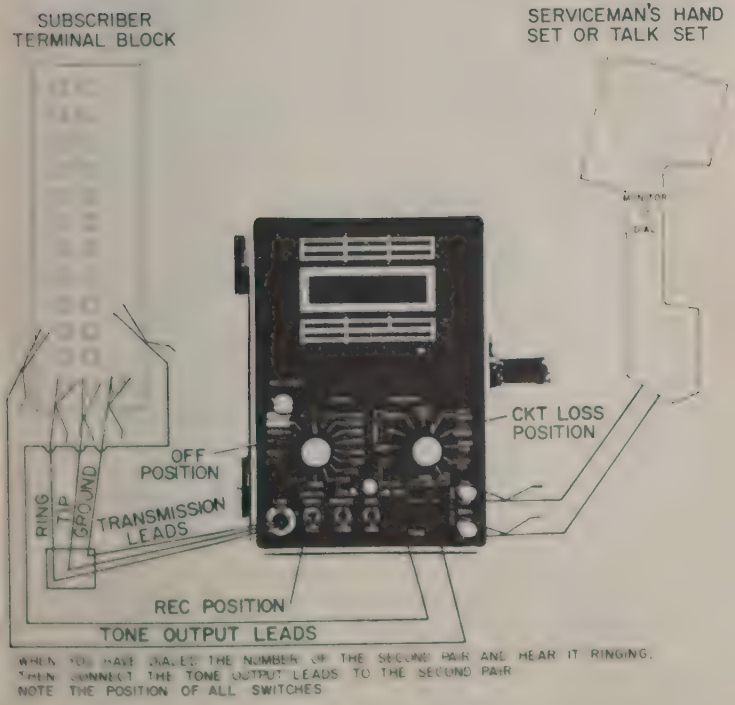


Figure 7

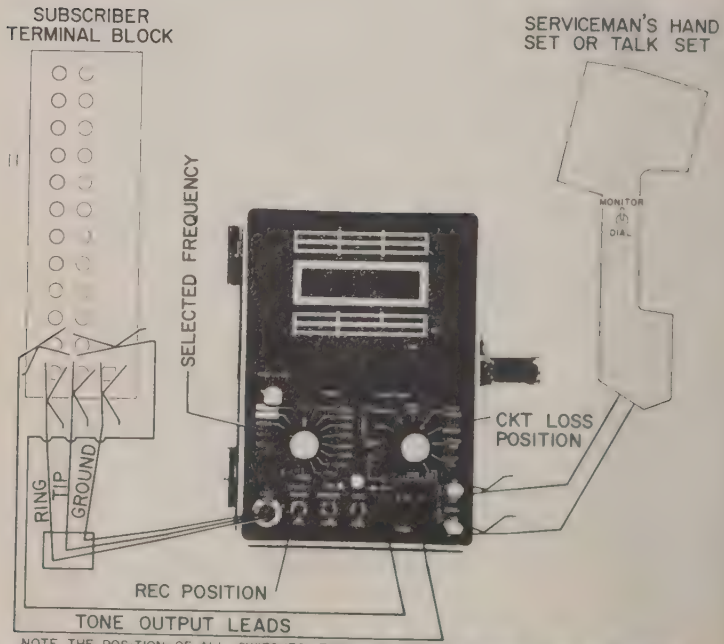

SUBSCRIBER
TERMINAL BLOCK
SERVICEMAN'S HAND
SET OR TALK SET
MONITOR
DIAL
SELECTED FREQUENCY
CKT LOSS
POSITION
RING
TIP
GROUND
REC POSITION
TONE OUTPUT LEADS
NOTE THE POSITION OF ALL SWITCHES THEY ARE SET FOR CIRCUIT LOSS MEASUREMENT
IS TO I7 TONES CAN BE SENT THROUGH THE SECOND PAIR TO THE CENTRAL OFFICE AND
BACK ON THE FIRST PAIR REVERSE THE LEADS CONNECTING THE TRANSMISSION LEADS
TO THE SECOND PAIR AND DIALING THE FIRST TO CHECK CIRCUIT LOSS IN THE OPPOSITE
DIRECTION

Figure 8

Testing For Circuit Noise - Standard Procedure

1. Refer to the Circuit Loss Testing - Standard Procedure Section. Setting up the Model 5 to test for Circuit Noise is exactly the same as Steps 1 through 4 of those Instructions. (See Illustration, Figure #5, Page 18)

2. Instead of dialing the access number of a tone source, the operator should dial the access number of a "Quiet Termination".

3. When the operator hears the line go "Quiet", he should then turn the Function Selector Switch to the "Circuit Noise" position. (See Illustration, Figure #5.)

4. The meter will now be indicating the circuit noise level in that pair from the Central Office to the point of test. You are measuring the noise metallic with "C" message weighting between the tip and ring of the subscriber loop.

5. Record the noise level indicated on the meter and listen through the hand-set to the "monitor" mode to identify what may be the source of that noise.

Loop-Around Testing For Circuit Noise

1. Follow Steps 1 through 4 as listed under "Testing For Circuit Loss - Standard Procedure".

2. Connect Tone leads to second pair of wires and dial the number of this pair.

3. When ringing is heard through hand set turn FUNCTION switch to CKT NOISE, Push-Push switch to ON, and hand set to monitor.

4. With TONE switch OFF a quiet termination is provided to the Tone leads. Record noise level indicated on meter.

5. If a high level is read, use a third pair to detemine which of the first two has excessive noise.

Testing For Power Influence - Standard Procedure

This is exactly the same procedure as with Circuit Noise testing. The one exception is that the Function Selector Switch is turned to the Power Influence position after a quiet termination is dialed. (See Illustration, Figure #5.)

LOOP-AROUND TESTING FOR CIRCUIT NOISE

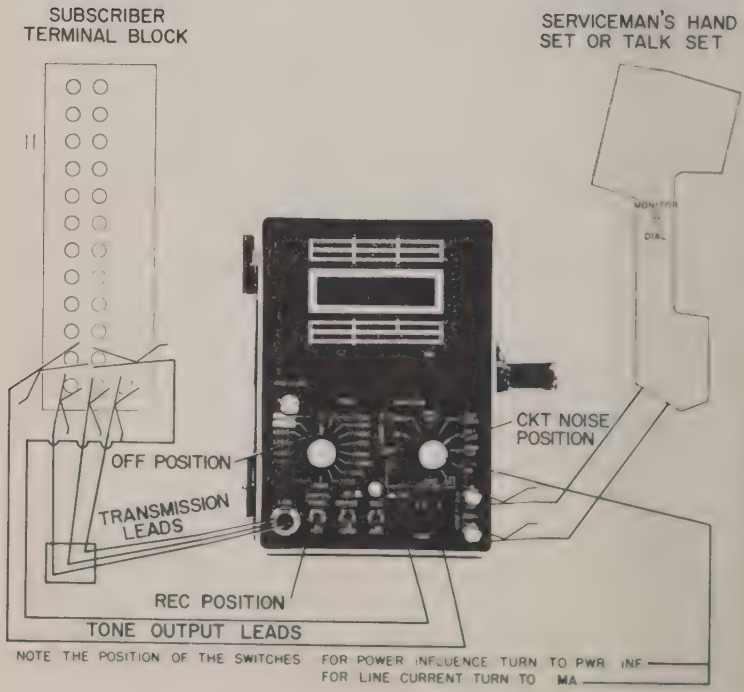


Figure 9

Loop-Around Testing For Power Influence

Loop-Around testing for Circuit Noise is exactly the same as for Power Influence with the one exception that when the loop has been established that the Function Switch is turned to the Power Influence position. Record the level and listen to the noise for possible identification or location. (See Illustrations, Figures #7 and #9.)

Line or Loop Current (Milliamps) Testing - Standard Procedure

This test is also performed the same as Circuit Noise Standard Procedure testing, with the following exception. (See Illustration, Figure #4.)

When the quiet termination has been dialed, the Function Selector Switch is turned on the MA position.

Loop-Around Testing Of The Loop Current (Milliamps)

Loop-Around testing for Loop Current is the same for Circuit Noise and Power Influence with the same exception as listed above. (See Illustrations, Figures #7 and #9.)

TIME SAVING TECHNIQUES
TESTING WITH THE MODEL 5

If you have practiced performing each of the Transmission Tests, both Standard Procedure and the Loop-Around Procedure, you will have noticed many repetitions of exactly the same steps. The operator can perform all four Standard Procedure Tests rapidly together. He can perform the four Loop-Around Tests equally as fast.

Grouping the Four Transmission Tests - Standard Procedure

1. Set up to test, referring to the first five steps of the Circuit Loss - Standard Procedure Section. (See Illustration, Figure #4.)

2. Follow Steps 6 and 7 to complete the Circuit Loss Test.

3. Return the Function Selector Switch to the "Off" position and dial the access number of a quiet termination.

4. Turn the Function Selector Switch to the "Circuit Noise" position and take a reading then listen.

5. Don't return the dial to "Off". Turn the Function Selector Switch to the "Power Influence" position. Take a reading then listen.

6. Don't return the dial to "Off". Turn the Function Selector Switch to the "Line Current" positions and take a reading.

• Note that the last three tests were performed while connected to the same quiet termination without need to break that connection or to redial.

* Note that all four tests were performed without the need to change any connections of the test leads. Tones could have been sent to the Central Office without changing the lead connections also. (Refer to Step 8 of the Circuit Loss - Standard Procedure.) (See Illustration, Figure #5.)

Grouping the Four Loop-Around Transmission Tests

1. Set up to test, referring to the first three steps of the Loop-Around Circuit Loss Test. (See Illustration, Figure #7.)
2. Follow Steps 4 through 8 to complete your Circuit Loss test. (See Illustration, Figure #8.)
3. Turn the Function Switch to the "Circuit Noise" position. Turn the left hand Rotary Selector Switch to the "Off" position. (See Illustration, Figure #9.)
4. Turn the Function Selector Switch to the "Power Influence" position. Record the reading and listen.
5. Turn the Function Selector Switch to the Line Current position and take a reading.

* Note that no redialing was necessary for all four tests.

* Note all four tests were performed without changing any lead connections. The one possible exception to this is if the operator wants to check the loss in the pairs in both directions.

TONE GENERATOR FUNCTIONS (17 TONE OSCILLATOR)

The Tone Generator portion of the Model 5 Loop Tester is in the same case as the Transmission Tester and Volt-Ohmmeter functions. However, electronically, the Tone Generator is a completely separate circuit. It can be used in conjunction with the Transmission Tester function as in the Loop-Around Transmission Tests. It can be used separately for many purposes where one or more tones are needed or to supply a quiet termination.

Additional Tone Generator Uses

1. Sending tones to the Central Office for testing Circuit Loss in the opposite direction. (See the Circuit Loss Testing - Standard Procedure Section, Step 8.) (See Illustration, Figure #5.)
2. Supplying a tone for pair sorting. (See Illustration, Figure #10.)*
3. Supplying a tone for cable tracing. (See Illustration, Figure #10.)*
4. Supplying a tone for continuity checking. (See Illustration, Figure #10.)*

USING THE MODEL 5 FOR SENDING TONES INTO A PAIR

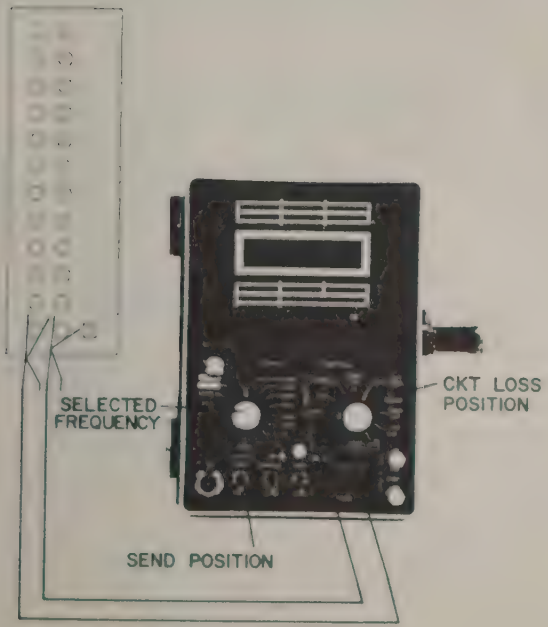


Figure 10

5. Some of the fifteen tones built into the tester can be used for special applications. An example is the 2713 Hz tone. This tone can be used to trip relays in "T" Carrier Equipment and Data Equipment to allow for continuity tests of those lines. The Loop-Around capability of the Model 5 lends itself perfectly for this purpose.

6. There are two optional tone positions on the Tone Selector Switch. A kit is available from the Triplett Corp. that includes the correct resistors and instructions for inserting any tone desired between 100 Hz to 5000 Hz. The uses of these two tones are as varied as the variety of tones available.

Normal Generator Operation

1. Plug the Tone Output Leads into the Tone Output Jacks.
2. Connect those two leads to any pair of wires desired.
3. Switch the Tone Selector Switch to the tone to be transmitted. (See Illustration, Figure #10.)
4. Switch the Function Selector Switch to the Circuit Loss position.
5. Switch the Send/Receive Toggle Switch to the Send position. This allows you to see the dB level of the tone being transmitted and adjust to zero dB output.

Note: With the SEND/RECEIVE SW. in the Send position, Tone output is available at both the Tone (V-0) jacks and the Transmission Line Jack, and is also monitored by the meter. In the receive position Tone Output is available only at the Tone (V-0) jacks and is not monitored.

6. Several tones, up to 17, can be transmitted by rotating the Tone Selector Switch.

7. If you had to adjust the tone output to the zero dB level in Step 4, you can see that turning the Tone Level Adjustment to the right or left lowers or raises the tone output level. This adjustment can be used to transmit tones at a minus 40 dB to over a plus 5.5 dB.

8. **Quiet Termination** CKT LOSS position of Function Sw. **only.**

If a quiet termination should be required from the Tone Generator in either the Send or Receive position while operating in the CKT LOSS mode, turn the Tone generator on to any frequency and turn the level control completely CCW. A 600 Ohm quiet termination is then present at the output of the Tone generator.

Other Generator Operation

1. If the operator desires to send tones through the Transmission Test Leads for convenience and speed, he should do the following.

A. Turn the Function Selector Switch to the "Circuit Loss" position.

B. Turn the Tone Selector Switch to any tone.

C. Switch the Send/Receive Toggle Switch to the "Send" position. This is actually the same as normal operation but the Transmission Leads are connected to the pair to which the tone or tones are being sent. (See Illustration, Figure #6.)

2. Loop-Around Transmission Testing (Refer to the Loop-Around Circuit Loss Testing Section). Both sets of leads are used and the Send/Receive Toggle Switch is switched finally to the Receive position to take "Loss" readings. (See Illustrations, Figure #7 and #8.)

VOLT-OHMMETER OPERATION

The same jacks and leads are used for Volt-Ohm testing as the operator used for Tone Output. The V-O jacks are located near the lower right corner of the control face plate. Two leads with Western Electric style alligator clips attached are supplied. The red lead is plugged into the plus jack and the black lead into the minus jack. Select the parameter to be measured by means of the Function Switch.

MEASURING AC-DC VOLTS

1. Plug the leads into the V-O jacks.

2. Set the Function Switch to the voltage range required. Either AC or DC (Max. 200V)

Note: If the voltage being measured exceeds the range of the Function switch setting, the display will indicate overrange by displaying a 1. with the other digits blanked.

3. Connect the leads to the voltage source being measured.

MEASURING OHMS

1. Make sure the circuit is dead by checking for the presence of voltage in the circuit first.

2. Set the Function Switch to the range required and connect the leads to the circuit or component to be measured.

3. If tester overranges switch to the next highest range.

The ohmmeter circuit is a constant current type of circuit. Maximum open circuit voltage is approximately 8 to 9 volts depending on the condition of the 9 volt batteries. Test current for the different ranges is as follows:

200 OHM Range 10 mA
2K OHM Range 1 mA
2 Meg OHM Range 1 uA

PARTS LIST MODEL 5

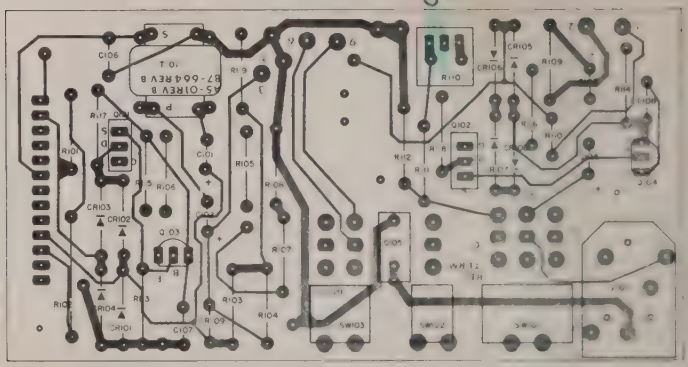
CKT.SYM	DESCRIPTION	PART NO.
BD100	PC BD, W/Comp, BDA100.	87-663
C101 thru C104	Cap. 47 UF 50 V	43-577
C105	Cap. .1 UF 200 V 20%	43-507
C106	Cap. 1000 PF 1 KV 10%	43-346
C107	Cap. 1 UF 50 V 50%	43-586
C108	Cap. 1 UF 50 V 50%	43-586
J101	Jack, Telephone	33-80
Q101	Transistor PWR Mos N-Channel	127-160
Q102	Transistor PWR Mos N-Channel	127-160
Q103	Trans. NPN Darlinton MPSA13	127-110
Q104	Trans. NPN Darlinton MPSA13	127-110
R101	Res. 10 1 W 1%	15-5860
R102	Res. 420 3 W 1%	15-5861
T101	Transformer 600 OHM 1:1.	23-234
CR101 thru CR108	Diode 1N4007 or Equiv.	127-91
CR109	Semiconductor Varistor	127-161
CR110	Semiconductor Varistor	127-161
SW101	Switch Toggle 3PDT	22-739
SW102	Switch, Toggle SPDT	22-777
SW103	Switch Toggle DPDT	22-740
BD200	PC BD, W/Comp, BDA200.	87-665
C201	Cap. .1 UF 50 V 10%	43-477
C202	Cap. 1 UF 50 V 10%	43-520
C203	Cap. 1 UF 50 V 10%	43-520
C204	Cap. 220 PF 1 KV 20%	43-372
C205	Cap. 22 UF 15 V 20%	43-497
C206	Cap. 22 UF 15 V 20%	43-497
C207	Cap. 1000 PF 1 KV 10%	43-346
C208	Cap. 390 PF 500 V 10%	43-325
C209	Cap. 470 PF 600 V 20%	43-149
Q201	Transistor, J-Fet N-Channel	127-127
R203	Res. 2K Film 10% Var.	16-291
R209	Res. 500 Film 10% Var.	16-288
R222	Res. 1 K Film 10% Var.	16-279

R225	Res. 600 3 W 1%	15-5862
R229	Res. 250 K Film 10% Var.	16-325
U201	IC Quad Op-Amp BIFET	126-120
U202	IC AD536 True Rms DC Conv.	126-112
CR201	IC V-Ref 1.22 Volts 9491AJ	126-150
CR203	Diode 1N4007 or Equiv.	127-91
SW201	Switch Rot. Function Select	22-778
BD300	PC BD, W/Comp, BDA300.	87-653
C301	Cap. .01 UF 63 V 1%	43-505
C302	Cap. .01 UF 63 V 1%	43-505
R310	Network Res. 15 Res Custom	159-10
R311	Network Res. 15 Res Custom	159-10
R313	Res. 2 K Film 10% Var.	16-291
R314	Res. 2 K Film 10% Var.	16-291
R315	Res. 500 Film 10% Var.	16-288
U301	IC Quad Op-AMP BIFET	126-120
CR301	Diode, Zener MZ4626 5.6V.	127-146
CR302	Diode, Zener MZ4626 5.6V.	127-146
SC301	Socket Singe-in-line 4 Pos	2455-365
SC302	Socket Singe-in-line 4 Pos	2455-365
SW301	Switch Rotary Tone Select.	22-738
BD400	PC BD, W/comp, BD400.	87-550
C401 thru C405	Cap. .01 UF 63 V 1%	43-505
C406	Cap. 150 PF 500 V 5%	43-391
C407 thru C411	Cap. .01 UF 63 V 1%	43-505
C412	Cap. 1800 PF 63 V 1%	43-509
C413	Cap. 10 UF 25 V 20%	43-414
C414	Cap. 10 UF 25 V 20%	43-414
R402	Res. 5 K Film 20% Var.	16-266
R410	Res. 2 K Film 20% Var.	16-270
R414	Res. 2K Film 20% Var.	16-270
U401	IC Quad OP-AMP BIFET	126-120

BD500	PC BD, W/Comp, BDA500.	87-667
C501	Cap. .22 UF 63 V 10%	43-454
C502	Cap. .22 UF 63 V 10%	43-454
C503	Cap. .047 UF 63 V 10%	43-517
C504	Cap. 100 PF 300 V 5%	43-387
C505	Cap. .15 UF 63 V 10%	43-519
C506	Cap. 470 PF 600 V 20%	43-149
Q501	Transistor 2N5089	127-37
R505	Res. 1 K Film 10% Var.	16-279
R510, R520	Res. 10 K Film 10% Var.	16-347
U501	IC Quad Exc*or*Gate 4070.	126-76
U502	IC 7106 3 1/2 Digit A/D	126-75
CR501	Diode, Zener MZ4626 5.6V.	127-146
CR502	Diode, Zener MZ4626 5.6V.	127-146
CR503	IC V-Ref 1.22 Volts 9491AJ	126-150
DS501	LCD 4 1/2 Dig .4" Hi Pin-	126-125

MISCELLANEOUS PARTS

	Case Assy.	10-3043
	Handle, Strap with Snap.	3206-64
	Strap Shoulder.	3206-63
	Battery Compartment Cover.	10-2817
	Cover Assy.	10-3042
	Panel Assembly, Front	28-1300
R 1	Res. 10 K Film 10%	16-318
SW 1	Switch, Pushbutton.	22-735
	Res. 10 K Film 10%	16-318
	Switch, Pushbutton	22-735
	Knob, Switch.	34-196
	Knob, Molded, Pushbutton	34-239
	Knob, Ohms & Tone Control.	34-198
	Display Assembly.	10-3300
	Front Assembly.	10-3301
	Window, Printed.	19-270
	Connector, 9V Battery, 9''	92-31
	Socket Banana Plug.	2455-379
	Lead Pkg Volt/Ohm.	79-548
	Lead Assy, Phone Plug.	79-493
	Lead WE310 Plug to Modular	79-519
	Lead Assy Modular to Clip	79-537
	Fuse, 1 AMP 8AG Littel Fuse	3207-43
B 1	Battery 9V, Mallory MN1604	37-48
B 2	Battery 9V, Mallory MN1604	37-48



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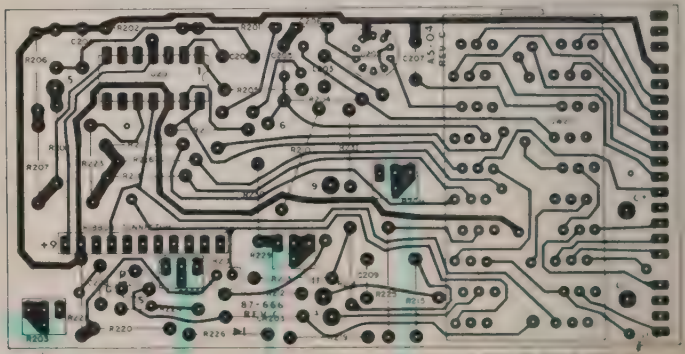

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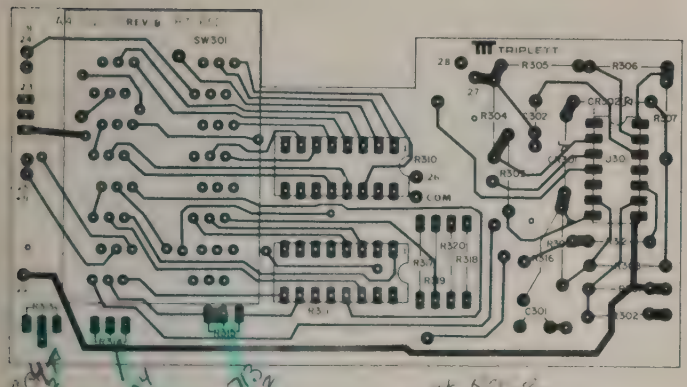
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HP ADJ

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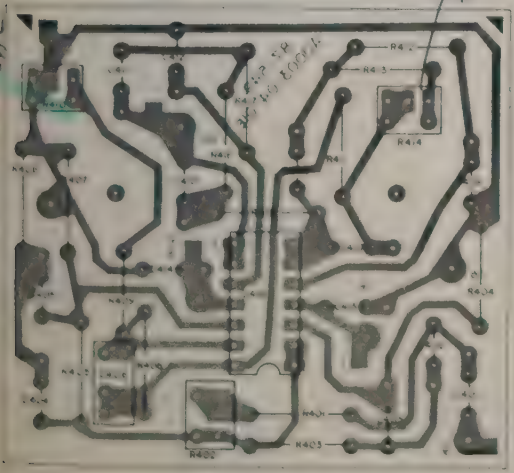
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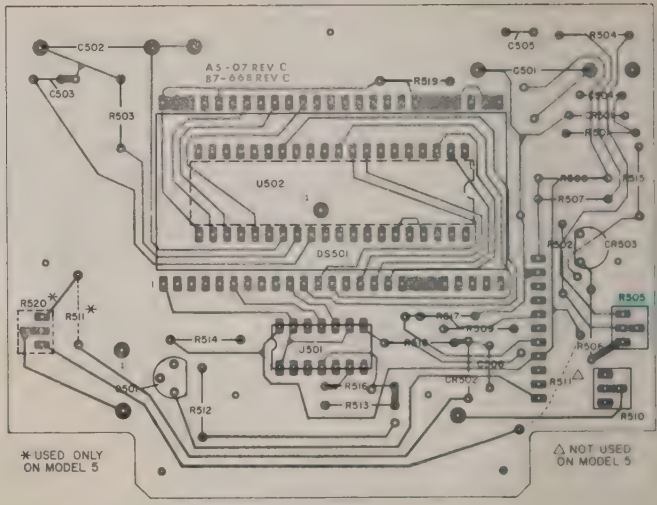
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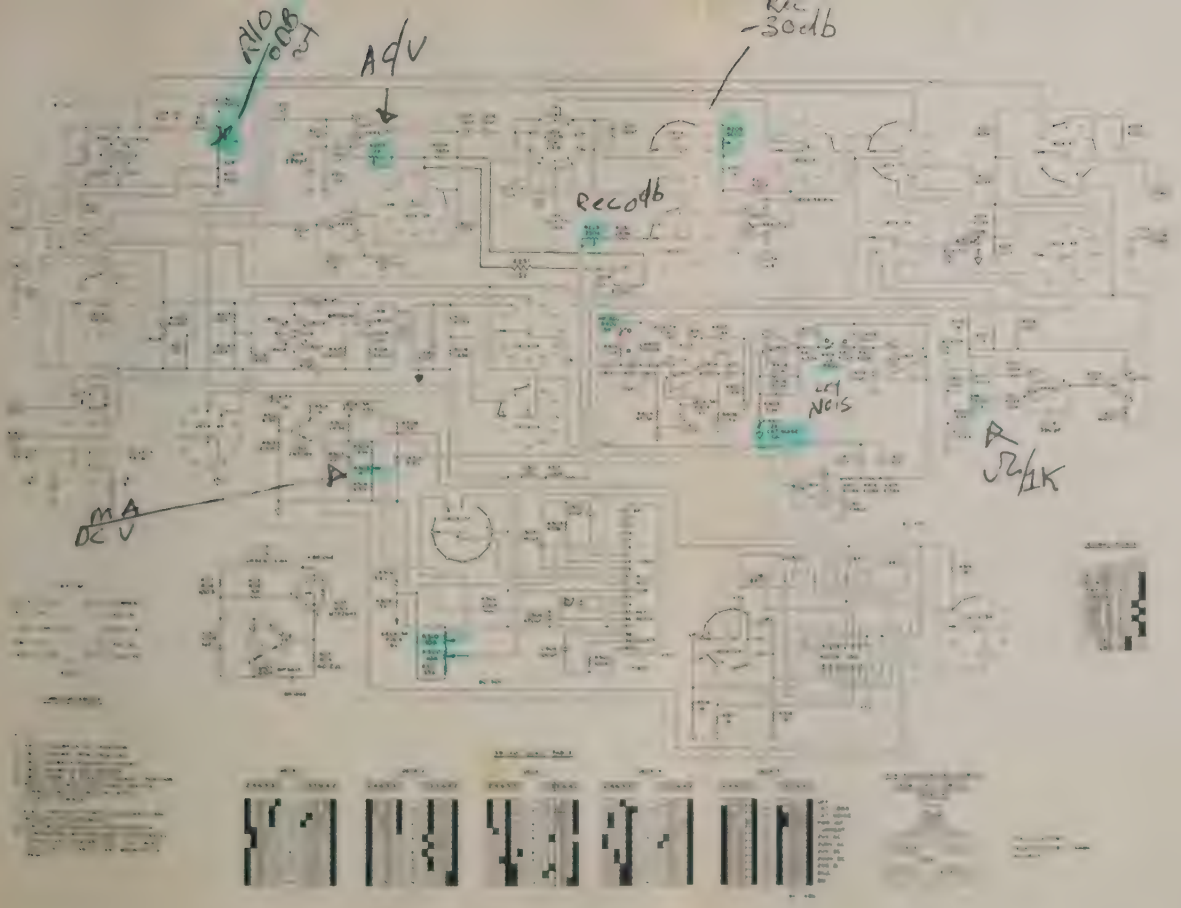
* USED ONLY ON MODEL 5
△ NOT USED ON MODEL 5

Bd 500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Printed in U.S.A. **Part No. 84-438 Rev. A**

NOTES:

TRIPLETT CORPORATION
ONE TRIPLETT DRIVE
BLUFFTON, OHIO 45817
TEL. (419) 358-5015
TWX. (810) 490-2400